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ABSTRACT

Gallery classes at the National Aquarium in Baltimore give the opportunity to study specific aquarium exhibits which demonstrate entire natural habitats. The coral reef gallery class features the gigantic western Atlantic coral reef (325,000 gallons) with over 1,000 fish. The exhibit simulates a typical Caribbean coral reef and nearby sandy lagoon. The class (which takes 45 to 50 minutes) begins with a brief introduction to corals and coral reefs in the classroom. Students then practice fish identification and observe fish behavior in the exhibit, using worksheets and identification boards. Upon returning to the classroom, students share their observations and learn more about fish behavior and ecology. This guide includes: (1) suggestions for activities before, during, and after the visit; (2) background information on coral reefs; (3) a crossword puzzle; (4) a worksheet on fish behavior (which may be duplicated for use during a teacher-led visit following the program); and (4) a list of suggested films (keyed by location and age/educational level). (JN)

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CORAL REEFS

A GALLERY PROGRAM
GRADES 7–12

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CORAL REEF

Gallery classes offer students the opportunity to study specific Aquarium exhibits which demonstrate entire natural habitats. The Coral Reef gallery class features the gigantic Western Atlantic Coral Reef (325,000 gallons) with over a thousand fish in residence. This exhibit simulates a typical Caribbean coral reef and nearby sandy lagoon. The donut shaped design and the variety of areas from open sand to dense coral encourage natural behavior among reef residents ranging from small territorial damselfish to large predatory tarpon.

The class will begin with a brief introduction to corals and coral reefs in the classroom. Students will then practice fish identification and observe fish behavior in the Coral Reef exhibit,using worksheets and identification boards. Upon returning to the classroom students will share their observations and learn more about fish behavior and ecology. A worksheet is enclosed which you may duplicate and use in the Coral Reef during your teacher-led visit following the program if you wish to extend the program. The class takes 45 to 50 minutes and must begin on time at 9:30 to take full advantage of the Aquarium before we open for the public.

PRE-VISIT ACTIVITIES SUGGESTIONS

1. Use a world map to locate the tropics. Then home in on coral reefs which are located between 23°N and S in the warm, clear salt water found along eastern edges of continents. Ocean currents carry cold polar water down the west coasts of continents, preventing coral growth. For example, coral reefs are found along the east coast of Africa but not the western side.

2. Review the following terms with your students.

aggression	photosynthesis
algae	predator
carnivore	prey
herbivore	symbiosis
mutualism	territory
omnivore	tropics
parasite	

DURING YOUR VISIT

1. After the program have your students complete the enclosed FISH BEHAVIOR worksheet during the teacher-led portion of your visit. Each student should have a clipboard with the pen or pencil attached with a string. Do not distribute the worksheets until the Coral Reef program is finished. Allow the students to pick their favorite fish for this detailed study. On the following day at school review the students' observations.

POST-VISIT ACTIVITIES SUGGESTIONS

1. In addition to the report on their fish behavior observations, have students color their drawings and put them in the correct location on a reef cross section drawn on the board or on butcher paper.

2. Get carried away. Use papier mache, crepe paper, etc. to turn a corner or the whole classroom into a coral reef. Balloons make a good mold for fish papier mache. Do not neglect the invertebrates. Styrofoam balls with toothpicks for sea urchins, sea fans from pipe cleaners, and saran wrap and wire jellyfish are just a few ideas.

3. Geography and history may be related to this program through a study of the Caribbean islands and their people. Students could choose islands as the subjects for reports presented on a Caribbean day, including food, costumes and music. Be sure to provide a large map and a timeline for dates as a backdrop for the reports.

4. Give your class the enclosed Coral Reef Crossword Puzzle as a review. The answers are:

Across	Down
1. trigger	1. turtle
3. stingray	2. equator
7. coral	4. grunts
9. parrotfish	5. hog
11. tropics	6. clear
12. lookdown	8. warm
	10. tarpon

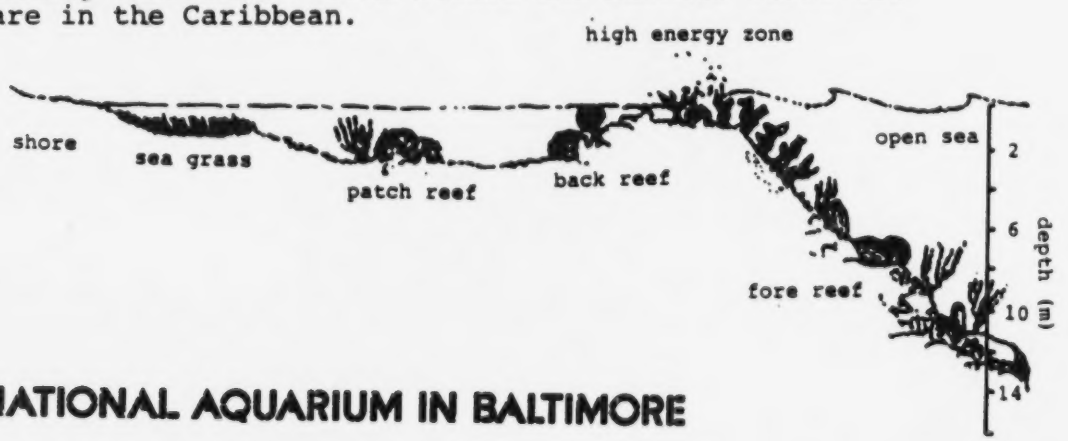
CORAL REEF
a fact sheet

Coral reefs rise up above sandy ocean floors in some areas of the world. The mass of the reef is composed of calcium carbonate laid down by animals called stony corals (also called hard corals). The surface of the reef is covered by the living part of the corals. Where dead corals are on the surface, algae and an abundance of invertebrates settle. Around this structure a diverse assemblage of fish live and feed.

Corals (this word will be used to refer to stony corals) have some very specific requirements for growth which limit their distribution. Reef-building corals are restricted to warm water (24°C optimum). Since polar waters move down along the western margins of continents, reefs are generally restricted to the eastern margins. Consequently, coral reefs form off the coast of Florida but not California. The major areas of reef development are the Caribbean and the Indo-Pacific regions.

Reef-building corals all have endosymbiotic algae called zooxanthellae living in their tissue. These algae require light in order to do photosynthesis so their hosts are restricted to relatively shallow (30 m) clear water. Sediment or turbid water kills corals. Areas with high freshwater run-off also lack corals since corals require at least 25ppt salt and do best in full seawater(35ppt).

Caribbean reefs are bank or fringe reefs pictured below in cross section. In the Indo-Pacific, atolls form on sinking volcanoes; and the Great Barrier reef formed on a sinking coastline. Both atolls and barrier reefs are rare in the Caribbean.



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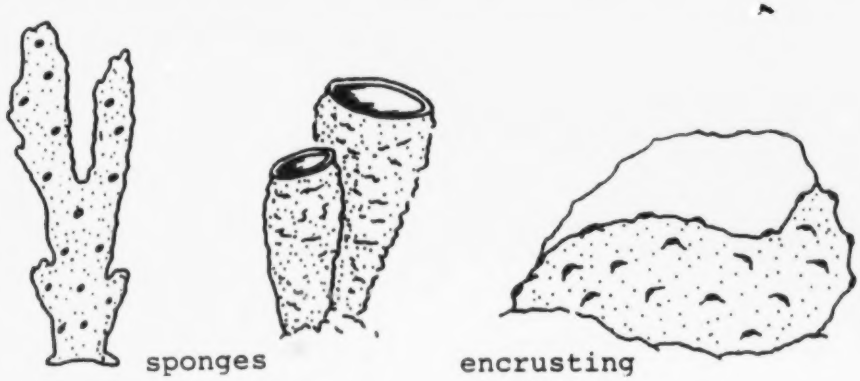
Coral diversity is much lower in the Caribbean. There are 20 genera of corals in the Caribbean with 35 common species while there are 80 genera and some 700 species in the Indo-Pacific. For example, there are 3 species of Acropora in the Caribbean and 150 in the Indo-Pacific. Fish diversity shows the same trend.

Red, brown and green algae are common on and around reefs. They are generally calcareous; that is, they lay down calcium carbonate between their cells. The reds contribute to the reef structure itself while the greens are a source of carbonate sand for the beaches.



sponges

encrusting sponge

Sponges in brilliant colors grow both as encrusting patches and as discrete shapes, including vase and basket sponges.

Animals belonging to the coelenterates are tremendously abundant. The stony corals are coelenterates. Anemones, gorgonians (sea whips and fans), fire coral and colonial anemone-like zooanthids are common.

Some molluscs live on the reef, but many more live in the sandy areas and grass beds around the reef. Arthropods are common, but many are too small to be noticed unless a diver examines the nooks and crannies of the reef very carefully.

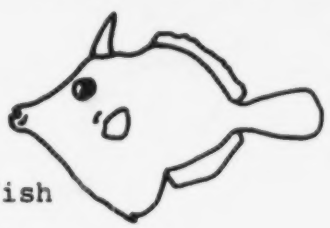
Fish are the most prominent animals on the reef, exhibiting glorious colors and fascinating ways of living.

The fish of the coral reef comprise the dominant conspicuous population of animals. Many of them possess peculiarities of feeding and swimming which can be correlated to specific anatomical designs and/or social behaviors. A careful observer will detect such traits and often can identify individual species readily.

Specializations in fish anatomy provide for efficient means of feeding, schooling and protection by a variety of fish. Many of the smaller, more slender fish, such as the damsels and wrasses, occupy crannies and breaks in the reef to protect themselves from predators and to ambush prey such as small crustaceans and worms without giving away their location.

A larger fish, the triggerfish, must utilize its speed and wedged head to chase prey into cornered areas and to pick food from tight spots which might otherwise inhibit normal open feeders. The trigger's mouth design also permits it to feed upon spiny sea urchins using a technique of "plucking" and "stabbing" to reach the soft body parts of the animal.

parrotfish



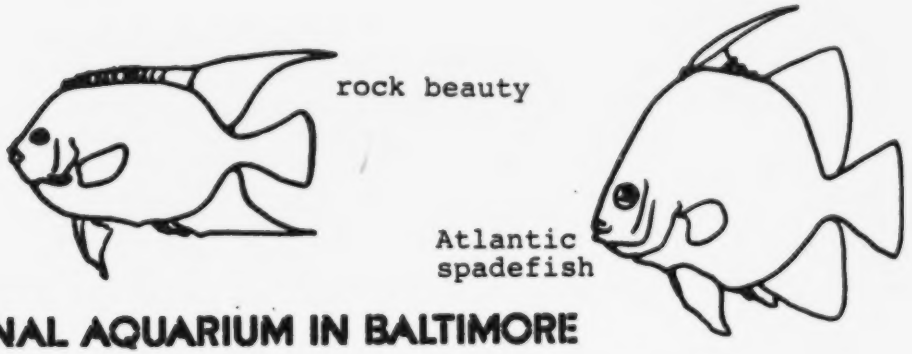
triggerfish

Parrotfish, besides their beautiful color, possess a special adaptation consisting of a bony "beak" rather than usual fish teeth. The bone of the teeth is fused together into upper and lower dental plates with a slit between upper left and right plates. Such a feature permits this fish to graze upon algae which grows on the coral by crunching pieces of the $CaCO_3$ with the attached vegetable matter. The coral bits are then ground in a bony mill in the throat and returned to the sediment in particulate and fine-grained form. The feeding mechanism of parrotfish may well account for the great accumulation of coral-derived sediments and "sand" deposits in and about reefs.

Defense adaptations and social organization among fish species represent a most important feature of living reefs. Many fish exhibit color change or swelling (puffers and boxfish) when alarmed which may thwart the attack of a would-be predator. Others, such as the four-eye butterfly, utilize simulated eye spots to direct predators to the wrong end (the tail), which in turn distracts the animal long enough for the butterfly to escape.

Since a coral reef comprises so many individuals of different fish and invertebrate species, encounters between individuals are common, if not continuous. Social hierarchies exist within many fish associations which establish dominance of males over other males, males over females, females over females, and sexually mature females over immature ones. This is particularly important since many fish change sex at some point in their development. Wrasses, parrotfish, angels and tangs make use of varied coloration to distinguish juvenile from adults or "phases" which signal sexual maturity or social prominence. Such structuring of fish populations is still under study, but present research indicates a high level of social organization in many fish species.

Trade-offs between fish of different species is often observed in the reef habitat. One may detect what appears to be "picking" or "biting" of a smaller fish on a larger one, while the victim does nothing to defend itself. Actually, what is occuring is cleaning behavior. The smaller fish resides in a semi-permanent territory of safety (and relative access to food) in exchange for cleaning and de-parasitizing larger fish. The cleaner maintains a recognized cleaning station. Cleaners usually are identified as the smaller fish, notably the porkfish and gobies.



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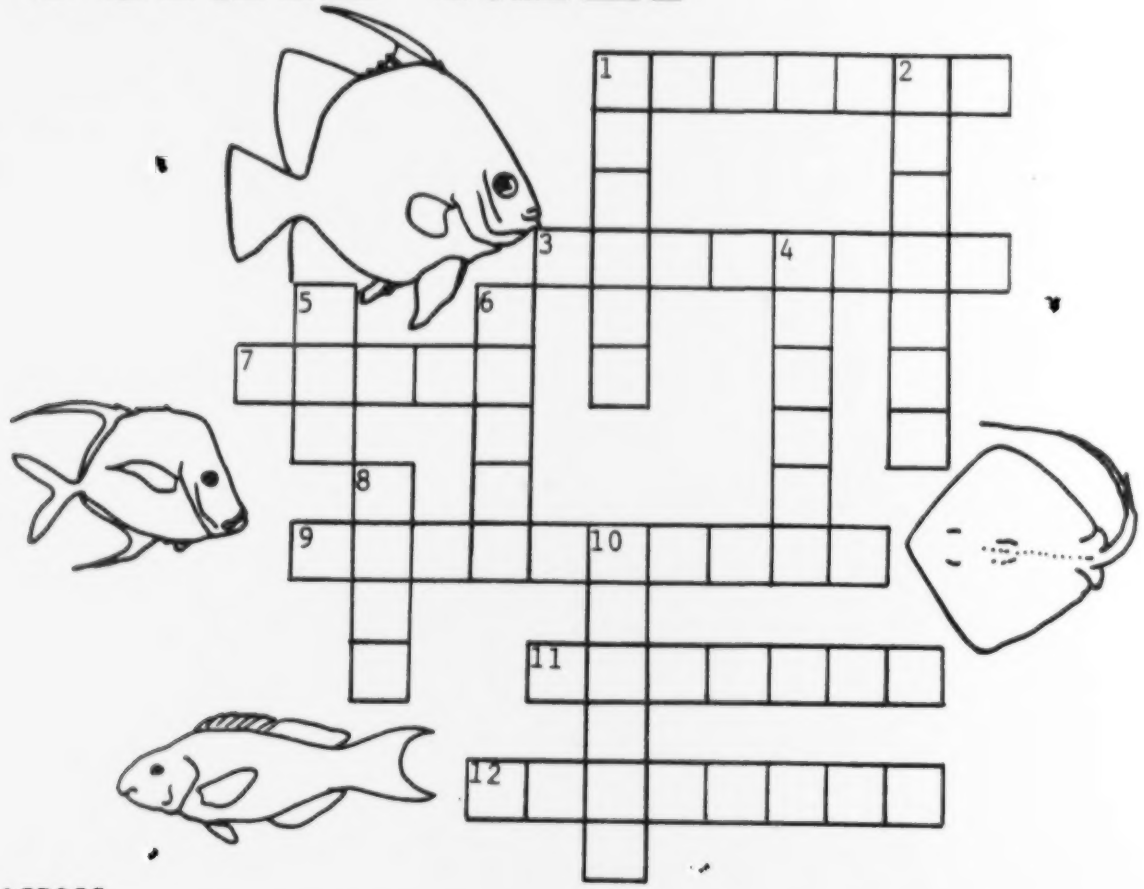
CORAL REEF



ACROSS

1. Black durgons are one of the _____ fish family, a group which have spines on their backs which lock upright.
3. A flat, cartilaginous fish which has a poisonous spine at the base of its tail.
7. Related to sea anemones; skeletons form reefs.
9. Fish with beaklike teeth used for scraping algae and coral.
11. Coral reefs are located in this general region of the world.
12. Thin, flat, tall, silver fish with a "pushed in" face.

DOWN

1. The hawksbill is an endangered sea _____.
2. The tropics are located north and south of this imaginary line around the world.
4. Common reef fish family named for the noise it makes when caught; for example, blue-striped and french _____.
5. Its long snout gave this fish its common name, _____ fish.
6. and 8. Corals that make reefs grow only in 6._____, 8._____ water.
10. Largest fish in the Aquarium's Coral Reef exhibit.

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Fish Behavior

NAME _____

YOU ARE GOING TO LEARN EVERYTHING YOU CAN ABOUT ONE SPECIES OF FISH BY MAKING YOUR OWN BEHAVIORAL OBSERVATIONS. CAREFULLY WATCH ONE KIND OF FISH IN THE WESTERN ATLANTIC CORAL REEF AND RECORD YOUR OBSERVATIONS. USE ID LABELS IF NECESSARY.

COMMON NAME _____

SCIENTIFIC NAME _____

WHERE IT LIVES (RANGE) _____

SIZE _____

COLORATION _____

SWIMS ALONE _____ SCHOOLS WITH OWN SPECIES ____ SCHOOLS MIXED _____

HOW DOES IT SWIM? WHERE DOES THE POWER COME FROM? FAST? SLOW? _____

_____

WHAT PART OF THE REEF DOES THE FISH OCCUPY? HIGH? LOW? OPEN? REEF? ___

_____

WHERE IS ITS MOUTH? _____

CAN YOU GUESS WHAT IT MIGHT EAT? _____

_____

DOES YOUR FISH HAVE ANY SPECIAL BEHAVIOR?

CLEANING? _____

_____

TERRITORY? _____

_____

INTERACTIONS WITH ITS OWN KIND? _____

_____

INTERACTIONS WITH FISH OF OTHER SPECIES? _____

_____

ANYTHING ELSE YOU HAVE DISCOVERED? _____

_____

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DRAW YOUR FISH TO <u>FILL</u> THE SPACE ON THE OTHER SIDE OF THIS PAGE. LABEL THE PARTS ON YOUR FISH.

Suggested Films

CORAL REEF

Numerous films are available in our area that can be used in conjunction with this program. Each is listed below, not only by library system, but also by the age level it is intended for.

KEY

Age Level:		Library System:	
P	Primary	C	Baltimore City
I	Intermediate	CO	Baltimore County
J	Jr. High	EP	Enoch-Pratt
H	High		
C	College		
G	General		

Camouflage in Nature: Form and Color	(C,CO)	I,J,H,C,G
Camouflage in Nature: Pattern	(C,CO)	I,J,H,C,G
Animal Communities	(C)	I,J
Plant and Animal Distribution	(C)	H,C
Plant and Animal Communities: Interrelationships	(C)	
Life in the Sea	(C)	I,J
Exploring the Ocean	(C)	I,J
The Sea	(C)	I,J,H,C,G
Food Chains in the Ocean	(CO)	I,J
Great Barrier Reef: Part 1	(CO)	J,H,C
Great Barrier Reef: Part 2	(CO)	J,H,C
Secrets of the Sea	(CO)	I,J,H,C,G
Coral Wonderland	(EP)	H,C,G

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